

Hutchings 2003 Midterm  
2 a. Normal to  $x^2 + y^2 + z^2 = 14$   
at  $(3, 2, 1)$

normal is  $\nabla f(x_0, y_0, z_0)$   
 $\nabla f = \langle 2x, 2y, 2z \rangle$

=

$$\langle 6, 4, 2 \rangle$$

b Find tangent plane to surface  $z = x^2 - y^2$   
at point  $(2, 1, 3)$

Tangent plane =

$$z - z_0 = f_x(x_0, y_0)(x - x_0) + f_y(x_0, y_0)(y - y_0)$$
$$z - z_0 = 2x_0(x - x_0) + -2y_0(y - y_0)$$
$$z - 3 = 4(x - 2) + -2(y - 1)$$

$$z = 4x - 2y - 3$$